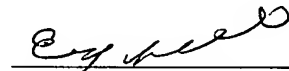


REMARKS

The changes are shown with strikethrough for deleted matter and underlining for added matter. No new matter has been added as a result of this amendment. Applicants respectfully submit that all of the pending claims are in condition for allowance and seek an early allowance thereof. If for any reason the Examiner is unable to allow the application in the next Office Action and believes that a telephone interview would be helpful to resolve any remaining issues, he is respectfully requested to contact the undersigned attorney or agent.

Respectfully submitted,



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Substitute Specification - marked up version

Our Case No. 11371/125

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
APPLICATION FOR UNITED STATES LETTERS PATENT

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TITLE:

Housing Comprising a Liquid-Tight
Electric Bushing

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Substitute Specification - marked up version

HOUSING COMPRISING A LIQUID-TIGHT ELECTRIC BUSHING

[0001] The present patent document is a continuation of PCT Application Serial Number PCT/EP2004/053712, filed December 27, 2004, designating the United States, which is hereby incorporated by reference.

~~Background~~BACKGROUND

Field

[0002] ~~The invention relates to a~~The present embodiments relate to a housing having a liquid-tight electric bushing, ~~as generically defined by the preamble to claim 1.~~

Related Art

[0003] ~~The invention relates in particular to housings of X-ray emitters. In the X-ray emitters known from the prior art, an X-ray tube is received in a housing. For cooling the X-ray tube, coolant~~During the operation of the X-ray tube, coolant oil is circulated through the housing at an overpressure to cool the X-ray tube. ~~Electric~~Electric lines for triggering and monitoring the X-ray tube are guided through the housing wall by ~~means of a closure which that~~ closes an opening in the housing in liquid-tight fashion. ~~Especially because of the properties of the coolant oil, it repeatedly happens in practice that cooling~~Coolant oil creeps flows to the outside of the housing via along contact pins that are ~~not integrally disposed~~ in the closure and emerges in an unwanted way on the outside of the housing. ~~Aside from this, the production of~~Conventional closures involves relatively great effort to produce, and thus, they are expensive. There is a need for a housing with improved tightness and a simplistic design.

~~Summary~~SUMMARY

~~[0004]— It is the object of the invention to eliminate the disadvantages of the prior art. In particular, an electric bushing for a housing is to be disclosed that can be produced as simply and economically as possible and that has improved tightness. This object is attained by the characteristics of claim 1. Expedient features will become apparent from the characteristics of claims 2 through 28.~~

~~[0005]— [0004]~~ The present embodiments are directed to a housing comprising a liquid-tight electric bushing, which may obviate one or more of the problems due to the limitations and disadvantages of the related art.

~~[0005]— A housing having a liquid-tight electric bushing comprises an opening and a printed circuit board. In accordance with the invention, it is provided that the closure is—~~The a printed circuit board (pcb) is a closure that comprises at least first and second layers, embodied in multiple layers. Using a printed circuit board makes it possible to produce an electric bushing for a housing simply and economically.

~~[0005]~~ Advantageously, the ~~The printed circuit board is mounted on the housing in such a way that a first layer, pointing layer points toward the a housing interior and forming forms a top side of the printed circuit board, which spans the opening. Because the printed circuit board is mounted on the housing in such a way that a first layer, pointing toward the housing interior and forming a top side of the printed circuit board, spans the opening, creeping—~~The printed circuit board prevents the flowing of a liquid received in the housing to the outside of the housing and provides a closure with improved tightness. through the printed circuit board is prevented securely and reliably. The proposed closure has improved tightness.

~~[0006]— Advantageously, at least one~~A first contact element is provided on the top side—. ~~The first contact element serves to connect~~is coupled to ~~at least one electric line received in the housing—.~~ The first layer is expediently produced from an electrical insulation material. It is thus~~Thus, assured that the closure is electrically insulated from the housing.~~

[0007] The first contact element is disposed through a blind bore in the first layer and extends to at least the second layer. The bore contributes to preventing liquid received in the housing from flowing transversely through the layers of the printed circuit board.

[0008] ~~In a further feature~~In another embodiment, the first contact element is connected electrically to a second contact element via at least one conductor track, which is guided in the interior of the printed circuit board and forming forms a second layer. ~~For contacting t~~The first contact element, is disposed through a blind bore reaching through in the first layer and extending extends to at as far as the least the second layer is advantageously provided. The provision of a blind bore contributes to preventing the liquid received in the housing from being able to creep flowing transversely through the layers of the printed circuit board.

[0009] The second contact element is provided ~~disposed~~ on an underside located that is opposite the top side. ~~However, it and also be extended to the outside~~extends outside at an edge of the printed circuit board.

~~[0007]~~ [0010] ~~In a further feature~~In another embodiment, it is provided that the printed circuit board is flexible. ~~This makes~~ Thus, simple adaptation is possible, for instance ~~example~~, to non-plane geometries of the opening that are not planar.

~~[0008]~~ [0011] Advantageously, ~~t~~The printed circuit board has a plurality of second layers of conductor tracks disposed one above the other. ~~, located one above the other, of conductor tracks.~~In this case, the first contact element and the second contact element may be connected via a plurality of conductor tracks, ~~located one above the other~~which are disposed one above the other and are electrically connected coupled to each other to one another electrically conductively. In this embodiment, the housing is liquid tight Tightness under extreme loads can thus be assured.

~~[0009]—[0012]~~ In another embodiment, it is provided that a seal is provided between the printed circuit board and the housing. Moreover, a pressure plate contacting the underside of the printed circuit board and may be provided for pressing presses the printed circuit board against the seal, which can simplify assembly. ~~Such a pressure plate makes simple assembly possible. Besides this, Because the printed circuit board can additionally be is mechanically stabilized, the housing is protected against mechanically, for instance example, against an overpressure prevailing present in the housing.~~

~~[0010]—[0013]~~ The proposed electric bushing is fundamentally present ~~embodiments are suitable for many types of housings that are filled with a liquid, for Example, s that can be considered are motor housings and gearboxes, reactors for performing that perform chemical reactions, and the housings of heating and cooling systems, and the like. In particular, t~~ The proposed electric bushing is also suitable for producing an X-ray device. In that this case, an X-ray tube is received disposed in the housing.

~~[0011]—[0014]~~ Also in accordance with the invention preferred ~~embodiments, the use of aa method of using a printed circuit board as a closure for liquid-tight closing of an opening, which is provided in a housing housing, and as an electric bushing is contemplated provided.~~

~~[0012]—[0015]~~ With regard to the advantageous embodiment of the use method, the aforementioned characteristics are referred to, which can logically likewise form embodiments of the use method.

~~[0017]—Exemplary embodiments of the invention will be described below in further detail in conjunction with the drawings. Shown are:~~

~~Brief Description of the Drawings~~ **BRIEF DESCRIPTION OF THE DRAWINGS**

~~[0016]~~ Further advantages, characteristics and details will become apparent from the ensuing exemplary embodiments and from the drawings. In the drawings:

~~[0018]~~—~~[0017]~~ Figure 1, 1 is a sectional view through of a first exemplary embodiment; and

~~[0019]~~—~~[0018]~~ Figure 2, is a sectional view through of a second exemplary embodiment.

~~Detailed Description of the Presently Preferred Embodiments~~ **DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS**

~~[0020]~~—~~[0019]~~ In the first exemplary embodiment shown in Figure 1, a housing 1 has an opening 2. A printed circuit board 3 has a first layer 4, made from an electrical insulation material, which points toward the interior of the housing 1 and spans the opening 2. The first layer 4 forms a top side O of the printed circuit board 3. In the interior of the printed circuit board 3, ~~in an arrangement one above the other,~~ a plurality of electrically conductive second layers 5 are provided in an arrangement one above the other. ~~The second layers 5 which~~ are electrically ~~conductively connected coupled~~ to one another via a bridge 6. ~~For example, The~~ second layers 5 are ~~expediently likewise~~ conductor tracks. ~~An underside U of the~~ printed circuit board 3, which is opposite the top side O, is formed of a third layer 7, ~~which that is again~~ made from an electrical insulation material. ~~A first blind bore 8~~ is provided in the first layer 4, and a second blind bore 9 is provided in the third layer 7. ~~A first contact element 10 is mounted on the top side O-is and connected connects~~ electrically ~~conductively~~ to the second layer 5 by ~~means of a first~~ connection 11 that is guided by the first ~~blind bore 8.~~ ~~A second electrical contact~~

element 12 provided on the underside U is also connected electrically ~~conductively~~ to the second layer 5 by ~~means of~~ a second connection 13 guided by the second blind bore 9. The first contact element 10 and the second contact element 12 are preferably mounted by SMD (surface mounted device) technology on the printed circuit board 3.

~~[0021]~~ [0020] As shown in Figure 1, Aa pressure plate 14 is mounted on the housing 1 by ~~means of a screw or screws 15.~~ The pressure plate 14 rests on the underside U of the printed circuit board 3 and presses the topside O, ~~opposite the underside U,~~ against an O-ring seal 16. ~~In this embodiment, The~~ the pressure plate 14 is ~~preferably embodied such that it spans a substantial portion of the opening 2 and thus stabilizes the printed circuit board 3 against liquid overpressure prevailing present in the housing 1.~~

~~[0022]~~ [0021] In the exemplary embodiment shown in Figure 2, the printed circuit board 3 is retained on the housing 1 by ~~means of~~ a cap 17. In this ~~embodiment,~~ a portion of the printed circuit board 3 protrudes laterally out of the housing 1. ~~Instead of the second contact element 12,~~ The second layer 5 has a bent-over portion 18 on ~~the the~~ edge that ~~is extended~~ extends out of the housing 1. ~~This makes~~ In this embodiment, it possible to produce an electrical connection with the second layer 5 by, for ~~instance example,~~ by snapping a suitable flat plug onto the portion of the printed circuit board 3 that protrudes laterally from the housing 1.

~~[0023]~~ [0022] As can be seen from Figures 1 and 2, the opening 2 ~~in each case is~~ spanned by the first layer 4 of the printed circuit board 3. ~~Only i~~ In the first layer 4, ~~is a first blind bore 8 is provided, which that extends as far as the at least to the second layer 5. In particular, the~~ Because the printed circuit board 3 has no continuous opening ~~whatever. As a consequence, creeping opening, flowing of coolant oil, for instance, along such continuous~~ into a continuous openings of the kind used in the prior art is ~~securely and reliably prevented.~~ The ~~proposed electric~~

~~bushing can be realized simply and economically, using multi-layer printed circuit boards made by conventional techniques.~~

[0023] While the invention has been described above by reference to various embodiments, it should be understood that many changes and modifications can be made without departing from the scope of the invention. It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents, that are intended to define the spirit and scope of this invention.

~~Abstract~~ABSTRACT

~~[0021]—[0024]~~ The invention relates to a housing comprising a liquid-tight electric bushing is provided. ~~According to the invention, a passage (2) that is provided in the housing (1) is sealed by a seal that covers the electric bushing. To improve the impermeability, a multi-layer printed circuit board (3) constitutes the seal. The housing comprises an opening and a printed circuit board comprising at least first and second layers. The first layer is a top side of the printed circuit board and spans the opening. A first contact element is disposed on the top side and in a blind bore through the first layer that extends to the second layer. The second layer is a conductor track in the interior of the printed circuit board.~~